

EOS, TRANSACTIONS, AMERICAN GEOPHYSICAL UNION

VOL. 62, NO. 28, PAGES 577-584

JULY 14, 1981

Oceanography

3133 Boundary layer and exchange processes
REGIONAL VARIATIONS IN THE FREE ARCTIC OCEAN
AS OBSERVED AT T-1
James M. Wallace, Polar Science Center, University
of Washington, 2917 Roosevelt Way NE, Seattle,
WA 98105 and J. Bryan Smith, Geophysical Program,
University of Washington, Seattle, WA.
Hydrographic data from T-1 are analyzed to
characterize the behavior of the Arctic mixed layer.
The mixed layer depth fluctuates in a seasonally
and inter-annual manner. The mixed layer depth
fluctuates in a seasonally and inter-annual manner.
The mixed layer depth fluctuates in a seasonally
and inter-annual manner. The mixed layer depth
fluctuates in a seasonally and inter-annual manner.

4710 Chemical oceanography
CALCULATING THE OCEANIC CO₂ INCREASE: A NEED
FOR CAUTION
Alan R. Shiller, Scripps Institution of Oceanography,
University of California, San Diego, La Jolla,
California 92037
A number of scientists have presented preliminary
attempts to show the atmospheric CO₂ increase in
the ocean. These workers have calculated the CO₂
concentration of a water parcel to which it is
in contact with the atmosphere by using well-known
equations to correct for chemical changes induced by
biological decomposition. Because of the potential
significance of these CO₂ back-calculations,
their limitations are examined here. In the Arctic
Intermediate Water, which has been used as a
primary testing ground for these back-calculation
models, the results are significantly different from
previous calculations. The results show that the
use of these models is probably too high in the
Arctic Intermediate Water, and the ability
of these models to provide reliable estimates of
the oceanic CO₂ increase is in doubt. (Carbon
dioxide increases, Arctic Intermediate Water).
J. Geophys. Res., Ocean, Paper 100969

4711 Circulation
CIRCULATION OF THE CARIBBEAN SEA: A WELL-NO-
DOWN APPROACH
John R. Bullen, Woods Hole Oceanographic Institution,
Woods Hole, MA 01961, U.S.A.
The Caribbean Sea is isolated as a region where
the large scale circulation is well defined and
can be studied by hydrographic measurements through
application of the inverse method. A simple
example is used to illustrate the technique and to
demonstrate how some physical constraints on
circulation may be well defined in the basin.
understanding the large scale circulation in the
Caribbean Sea is found by applying the
inverse method to hydrographic measurements in
the basin. The results show that the large scale
circulation in the Caribbean Sea is well defined
and can be studied by hydrographic measurements
through application of the inverse method. A
simple example is used to illustrate the technique
and to demonstrate how some physical constraints
on circulation may be well defined in the basin.
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Caribbean Sea is found by applying the inverse
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in the Caribbean Sea is well defined and can be
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example is used to illustrate the technique and
to demonstrate how some physical constraints on
circulation may be well defined in the basin.

the east and flowing across the southern half
of the basin in the Caribbean Current, and
7 × 10¹⁸ m³ s⁻¹ entering from the north through
Windward Passage. Both of these currents show
small scale variability that distinguishes with
distance from the respective passages. The deep
flow has no net transport, as required by the
shallow out, but a well developed clockwise
circulation is found in the deep western Caribbean.
[Caribbean Sea, inverse method, general
circulation].
J. Geophys. Res., Ocean, Paper 100850

4750 Sea ice
SEA ICE DISPLACEMENT FROM SEASAT SYNTHETIC
APERTURE RADAR
R. L. Ball (Polar Science Center, University of
Washington, 4907 Roosevelt Way NE, Seattle, WA
98105) and D. A. Rothrock
Images obtained by a synthetic aperture radar on
SEASAT have been used to measure ice displacement
over a three day interval in October 1978.
The position of a natural ice feature was measured
on 5 October and again on 8 October; the difference
in these two positions is a displacement.
The tracked features lie roughly along a line and
are quite dense—about 2 km apart—over a distance
of 40 km. The displacement errors grow with
distance from shore becoming as large as 3 km.
The graph of displacement versus distance has
occasional discontinuities of several kilometers.
Displacement discontinuities are associated with
a shift in along track and 30 of their magnitude
is 0.01 to 0.02 km. [SEASAT].
J. Geophys. Res., Ocean, Paper 100944

4755 Surface waves, tides and sea level
STATISTICAL ANALYSIS OF THE TSUNAMI OF
MARCH 1952
Michele Compiègne, Istituto di Fisica "G. Galilei",
Università degli Studi, Roma, Italy
and Giuseppe Falga
The study of a catalogue of tsunamis of
magnitude 1 to 6 has allowed us to assign the
tsunami to a particular type of seismic event.
The analysis of the data of this catalogue
allows us to assign the tsunami to a particular
type of seismic event. The study of a catalogue
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allowed us to assign the tsunami to a particular
type of seismic event. The analysis of the data
of this catalogue allows us to assign the tsunami
to a particular type of seismic event.

4765 Surface waves, tides and sea level
MEASUREMENTS OF THE EQUILIBRIUM RANGE IN OCEAN
WAVE SPECTRA
George F. Stewart, Shell Development
Company, P.O. Box 441, Houston, Texas 77001
Measurements made in the Gulf of Mexico
and the North Atlantic Ocean have been used to
study the equilibrium range of ocean waves.
The analysis shows that the equilibrium range
of ocean waves is well defined and can be studied
by hydrographic measurements through application
of the inverse method. A simple example is used
to illustrate the technique and to demonstrate
how some physical constraints on circulation may
be well defined in the basin. understanding the
large scale circulation in the Caribbean Sea is
found by applying the inverse method to hydrographic
measurements in the basin. The results show that
the large scale circulation in the Caribbean Sea
is well defined and can be studied by hydrographic
measurements through application of the inverse
method. A simple example is used to illustrate
the technique and to demonstrate how some
physical constraints on circulation may be well
defined in the basin.

more period are known, the amplitude of the
of the spectrum can be predicted with some
accuracy. However, this relationship
should be used with caution when the height and
period statistics are influenced by swell.
J. Geophys. Res., Ocean, Paper 100548

4765 Surface waves
ON TIDAL INFLUENCES
Q. Ward (Harvard University Department of Geology,
20 Oxford Street, Cambridge, MA
02138)

Sea-level tsunami formation is detailed in this
paper using point source tensor sources with a
spherically symmetric, self-gravitating and elastic
Earth. Synthesis of vertical sea surface
displacements within 200 km and 100 seconds of
an event typically show an initial tsunami pulse
which grows and then evolves into dispersed wave
trains. The direction of first motion, the time
and the length scale of the developing pulse
contrast static concepts which assume tsunami
formation on permanent deformations of an
otherwise rigid sea floor supporting incompressible
water. The permanent strain field at the sea
floor is, in fact, irrelevant because it is
destroyed by frequent flexing of the sea floor
interior. Static concepts of tsunami
generation are especially misleading if they are
applied to sources, such as earthquakes, whose
motions are deeply rooted in elasticity theory.
The general point source tensor used here
provides a physically dependent causal mechanism
of tsunami generation. Pure dip and
strike slip sources, however, create waves that
are symmetric or anti-symmetric about the
center. Buried 10 km with a moment of 10¹⁸ N-m,
these sources generate initial tsunami pulses 40
km wide. Maximum amplitudes of 180 and 45
cm occur 10 km from the center, 60 s after the
dislocation. Tsunami from deeper earthquakes
are smaller, broader, and slower to develop
because they are deeper of the sea floor.
J. Geophys. Res., Ocean, Paper 100510

4790 Instruments and techniques
STATIONARY CALIBRATION
R. Volkov, VNIIGI (National Aeronautics and Space
Administration, Goddard Space Flight Center,
Greenbelt, MD 20771) C.F. Hertz
The Goddard Space Flight Center has been calibrated for
height bias using four overflight passes of
Orbview which were supported by the Goddard
Laser. The altimeter data was corrected for
tidal effects, using meteorological data taken
around the time of each pass; acceleration
and sea state bias, including both surface
waves and instrumental effects. Altimeter data
for each of the four passes was processed and
interpolated around the island. Interpolation
between passes produced an equivalent
altimeter response to the ground at the time
of the pass. The altimeter bias could be
estimated within the range of a meter.
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was estimated within the range of a meter.

Editorial

Students Wanted

To advance the scientific study of the earth and its environment in space is the first and primary purpose of the American Geophysical Union. In support of this purpose, one of the working goals of the AGU is to attract competent individual students and research workers to devote their attention to geophysics, and another is to stimulate high quality education for students interested in geophysics. Only by attracting new minds to address old problems and thus uncover new questions can we assure the health of our science. Many of our subdisciplines are having difficulty holding good students through their Ph.D.s because of the attractive opportunities available to them outside the research community. This is a challenge we must pick up—not just to fill our ranks, but to fill them with the cream of the upcoming generation.

Geophysics is by nature a focus of various disciplines on problems, and thus it has an inherent problem in capturing

the attention of students at the undergraduate level. There are tremendous opportunities for promising physics, chemistry, and mathematics majors who are totally unaware of the exciting direction their education and career could take. To assist you in identifying opportunities that could be passed on to undergraduates in your institution, Eos has begun carrying announcements of predoctoral scholarships, fellowships, and graduate assistantships without charge in the classified advertising section. The addition of these student positions expands the popular marketplace for jobs in the earth and space sciences that Eos has become. Many of these advertisements will be directed primarily to undergraduate students. Since Eos does not have a large circulation to undergraduates, success will depend on the information in this section being passed on by faculty advisors. You may want to copy these notices as they appear or post them or forward them to colleagues in other departments.

The inclusion of these announcements will be one in a

series of efforts to encourage good undergraduate students to pursue careers in geophysics. It is being guided by the Committee on Education and Human Resources, with strong support from the Oceanography Section in particular.

To use this new service, send your announcement of available student positions to Eos, Classified Advertising, American Geophysical Union, 2000 Florida Avenue, N.W., Washington, D.C. 20009. There will be no charge for the first insertion of such announcements so long as they are 20 lines or less. Subsequent insertions, if desired, will be run at half the regular classified advertising rate.

If you do place an announcement, please help to improve the service by evaluating its impact. Send me your evaluation with your thoughts on other ways to assure that we can do an even better job of attracting and holding good students in geophysics.

Fred Spilhaus

Continental Rifting: Progress and Outlook

B. H. Baker

Center for Geology
University of Oregon, Eugene

P. Morgan

Lunar and Planetary Institute
Houston, Texas

Increased research activity on continental rifting has led to a flood of new data in the last 15 years, but there is little consensus about the basic mechanisms and causes of rift



TRANSACTIONS, AMERICAN GEOPHYSICAL UNION

The Weekly Newspaper of Geophysics

Send double-spaced manuscripts (four copies) to Eos, AGU, 2000 Florida Avenue, N.W., Washington, D.C. 20009, or send them directly to one of the associate editors with a copy to the above address.

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Eos, Transactions, American Geophysical Union (ISSN 0096-3941) is published weekly by the American Geophysical Union from 2000 Florida Avenue, N.W., Washington, D.C. 20009. Subscription available on request. This issue \$5.00. Second-class postage paid at Washington, D.C., and at additional mailing offices.

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Cover. Photograph shows the MBT (mesosphere, stratosphere, troposphere) radar at Poker Flat, Alaska. This NSF-funded project was developed by the Aeronomy Laboratory of the National Oceanic and Atmospheric Administration to investigate atmospheric dynamics in the height range 2-100 km. The coherent (Doppler) radar system operates continuously to obtain data on winds, waves, turbulence, and atmospheric stability. System parameters for the complete system include a peak transmitted power of 5 MW and an antenna area of 4 × 10⁴ m². As seen in this photograph, the 64 transmitter modules are contained in separate buildings in the antenna array. The antenna is currently connected in a three-beam configuration (vertical, off-vertical to the east and to the north). Although completion is not scheduled until the end of 1981, the system is currently operating at a lower sensitivity. The building complex at the top of the photograph is the Poker Flat Rocket Research Range operated by the University of Alaska. (Photo taken by Paul E. Johnston and submitted by Ben B. Batley, both of the Aeronomy Lab, NOAA, Boulder, Colo.)

ing. The well-known association of tephrogonic features—volcanism, faulting, and volcanism—is widely regarded as the result of asthenospheric convection and lithosphere thinning. This concept is supported by observations of long-wavelength negative Bouguer anomalies, and of subnormal P_n velocities in the upper mantle, resulting from convective mass and heat transfer into the base of the lithosphere. Doming, and in some instances faulting, is the result of isostatic adjustment to the resulting expansion. The crust of rifts is abnormally thin (70–80% of normal) and contains high-density rocks assumed to be primarily intrusive basic igneous rocks. The collapse of rift floors may be the consequence of stress-induced lateral extension in the upper crust, possibly assisted by a mass excess of mafic intrusions in the rifted crust. Anomalous electrical conductivity (low) and heat flow (high) are the result of heating and magmatic and hydrothermal activity.

Sengör and Burke [1978] have distinguished two basic modes of rifting: active rifting, in which the lithosphere is cracked by asthenospheric upwelling, and passive rifting, in which a preliminary cracking of the lithosphere occurs because of differential stresses resulting from the interactions of lithospheric plates. A variety of data sets have been interpreted to produce cross sections of the major Cenozoic continental rifts, examples of which are shown in Figure 1. Basic similarities in these cross sections mask subtle structural and evolutionary differences between the rifts, however, and tell nothing of the processes of lithospheric thinning. It is not clear to what extent the anomalous lithospheric structure is a response, as opposed to a cause, of rifting. In a recent volume of papers on the mechanisms of graben formation [Wiles, 1981], both active and passive modes of rifting are discussed, the former mode primarily in connection with the East African rift system and the latter with reference to the Rhinegraben. The remarkable similarities in rift cross sections (Figure 1) suggest that the anomalous

lithospheric structure of rifts is more dependent on lithosphere properties than the mode of rifting.

It is clear that continental rifts are diverse and may form by a variety of processes. Some polarities on continental margins are regarded as "failed rifts" of spreading axes, and the East African rift may be a modern example of this type. Others are spatially and temporally connected with collision orogeny (Rhine; Bakkel), and some appear to be intraplate structures with no clear relation to other tectonic features (Ogö; mid-continent U.S.). Spatial categories are needed for rifts in complex tectonic settings such as the Basin and Range of the western U.S., which may be an expression of back-arc spreading related to subduction, locally modified by the stresses imparted by the San Andreas transform fault. The Snake River-Yellowstone zone is a grabenlike feature, an elongated depression associated with little or no extension, and could represent a "hot-spot" trace.

Viewed in this fashion it seems that there is a spectrum of rifting processes for which two fundamental mechanisms can be postulated, similar to the two modes of rifting distinguished by Sengör and Burke [1978]: an active mechanism whereby thermal energy is transmitted into the lithosphere from the underlying asthenosphere, and a passive mechanism by which mechanical energy is transmitted laterally through the lithosphere as a consequence of plate interactions of a distance. There may also be combinations of these two mechanisms. In order to allow the concept of the two fundamentally different mechanisms to be tested, we propose a tentative classification that divides rifts into the two basic categories:

Active Rifting:

- (1) Rift systems connected to midocean ridges and representing lateral extension as a result of asthenospheric convection. Structure is superimposed across older structures and has strong volcanism (e.g., East African rift system).
- (2) Smaller-scale rift zones generated by "plumes" or "hot-spots" with little or no regional extension. Localized domes are formed by volcanism, with a trail of inactive troughs and grabens (e.g., Snake River-Yellowstone zone).
- (3) Back-arc fault zones and grabens (e.g., Basin and Range, grabens of the Andes).

Passive Rifting:

- (1) Rifts associated with continental collision orogeny and formed by wedging and splitting of the lithosphere. The location and orientation is strongly influenced by preexisting structures, there is little igneous activity, and strike-slip motion may be locally important (e.g., Rhine-Rhone and Bakkel rifts).
- (2) Rifts associated with large strike-slip boundaries and resulting from the transmittal of shear stresses from the boundaries (e.g., western Turkey, Basin and Range). The magnitude of active rifting will depend on the rate at which lithosphere moves over the thermal source, with rifts being restricted to stationary or slow-moving plates (e.g., see Burke and Wilson, 1972). No such restriction applies to passive rifting, since the lithosphere thins in response to extension, and the source stresses are transmitted in the moving lithospheric plate. Other distinctions between the two mechanisms are in the influence of pre-rift structural elements, which should be strong for passive rifting and weak for active rifting. Sengör and Burke [1978] give different sequences of events for the two modes of rifting: the active mechanism predicts doming-volcanism-rifting; the passive mechanism rifting-(uplift?)-volcanism. For active rifting the magnitude of uplift and volume of igneous rocks should be much larger than for passive rifting, and a difference in igneous character may result: active—weakly alkaline to tholeiitic; passive—strongly alkaline (?).

Data relevant to the understanding of the processes are not restricted to the earth. For "one-plate" planets such as Mars, the processes of rifting are possibly easier to decipher, and the mechanisms can be applied to some rifts on Earth. The great Martian rift, Valles Marineris, is easily modeled in terms of the stress field imparted by the topography and the gravity field (Figure 2) [Phillips and Lambek, 1980]. The modeling results strongly suggest that the rift followed the formation of the Tharsis Plateau. Rifts are also found on Venus, a planet that ought to be as thermally active as the earth but appears to lack contemporary terrestrial

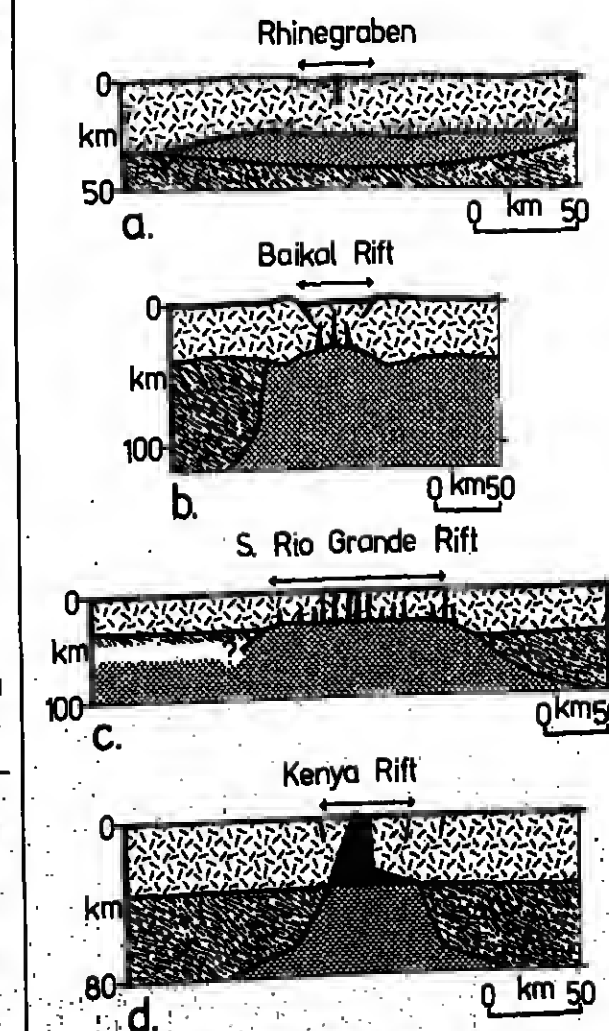


Fig. 1. Interpretive cross sections of (a) the Rhinegraben (adapted from Prodehl et al., 1978); (b) the Baikal rift (adapted from Zorin, 1981); (c) the southern Rio Grande rift (adapted from Sengör and Morgan, 1979); and (d) the Kenya rift (adapted from Baker and Morgan, 1979), based on a variety of data sets. Key: straight line pattern—crustal thinning; wavy line pattern—lithosphere; stippled pattern—asthenosphere or "normal" upper mantle; solid black pattern—basal crustal intrusions.

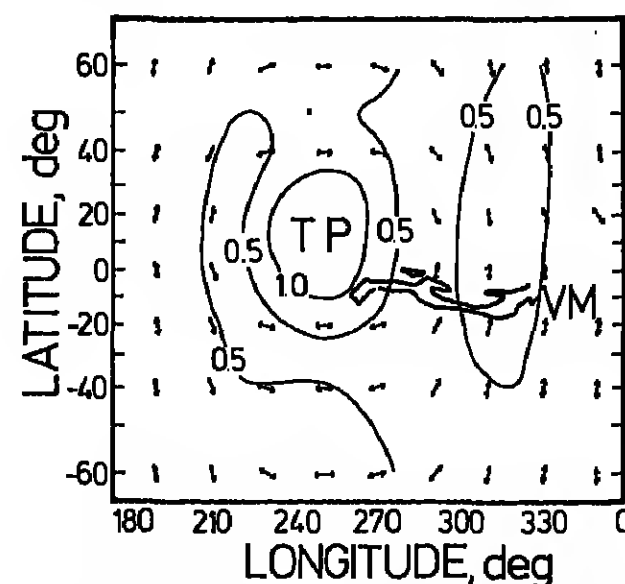


Fig. 2. Magnitude and direction of the theoretical horizontal tensile (principal) deviatoric stresses on the surface of the Tharsis Plateau (TP), Mars, imparted by the topography and the gravity field. Contours are magnitude of maximum stress, in kilobars. Note the orthogonal relationship between the Velleis Meridianis (VM) and the stresses. [Adapted from Phillips and Lembeck, 1980].

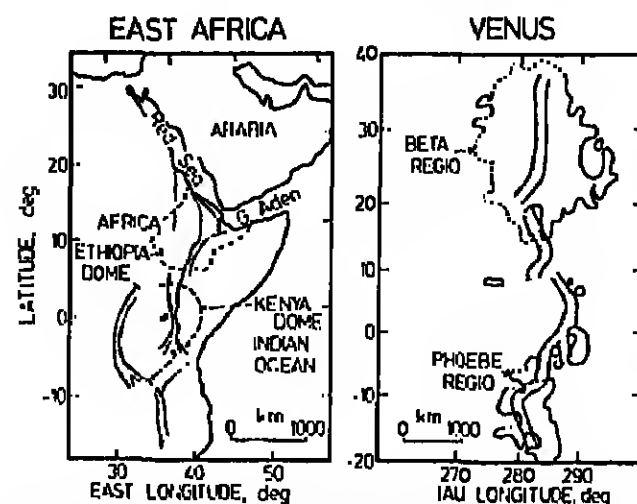


Fig. 3. Comparison between the East African rift system (cutting across the Ethiopian Dome and the Kenya Dome) and the major Venus rift system (cutting across the highlands of Beta Regio and Phoebe Regio). Depressions are indicated by the stipple pattern. [From George McColl, Univ. of Massachusetts, personal communication, 1981].

at-style plate tectonics. Analogies have been made between the Venus rifts and the East African rift system (Fig. 3), but the role of rifts in the tectonics of Venus is poorly understood at this time.

Hydrocarbon, mineral, and geothermal resources associated with rifting give an additional economic value to rift studies. Ideally models should predict the evolution of these resources. The diversity of rifts makes this a complex problem, however. In order to obtain a better understanding of rift processes and to apply adequate constraints to models, multidisciplinary studies of active rifts are needed to describe their evolution and to allow alternative mechanisms to be formulated and tested.

This problem and others will be addressed at a conference on the "Processes of Planetary Rifting," to be held December 3-5, 1981, at the Christen Brothers Retreat House in the Napa Valley, California. Immediately prior to the 1st Annual Meeting of the American Geophysical Union (in San Francisco). Persons interested in attending the rift meeting should contact the Projects Office, Lunar and Planetary Institute, 3303 Nasa Road One, Houston, Texas 77058 or call (713) 486-2150 for further information.

Acknowledgment

We thank R. J. Phillips for input and criticism of this manuscript.

References

- Baker, B. H., and J. Wohlenberg, Structure and evolution of the Kenya rift valley, *Nature*, 229, 538-542, 1971.
Burke, K., and J. T. Wilson, Is the African Plate stationary?, *Nature*, 239, 387-390, 1972.
Hess, J. H. (Ed.), Mechanism of Graben Formation, *Tectonophysics (Special Issue)*, 73, 268 pp., 1981.
Phillips, R. J., and K. Lembeck, Gravity fields of the terrestrial planets: long-wavelength anomalies and tectonics, *Rev. Geophys. Space Phys.*, 18, 27-76, 1980.
Probst, C. J., A. Seng, J. R. Edel, D. Emter, K. Fuchs, S. Mueller, and E. Peterschmitt, Explosion seismology research in the central and southern Rhine graben—A case history, in *Explosion Seismology in Central Europe*, edited by P. Gleiss, C. Probst, and A. Gleiss, pp. 313-320, Springer-Verlag, Berlin, 1978.
Sager, W. R., and P. Morgan, Rio Grande rift in southern New Mexico, west Texas, and northern Chihuahua, in *Rio Grande Rift: Tectonics and Magmatism*, edited by R. E. Flecker, 67-106, American Geophysical Union, Washington, D.C., 1978.
Seng, A. M. C., and K. Burke, Relative timing of rifting and volcanism on earth and its tectonic implications, *Geophys. Res. Lett.*, 5, 419-421, 1978.
Zorin, Yu. A., The Baikal rift: An example of the intrusion of asthenospheric material into the lithosphere as the cause of disruption of lithospheric plates, in *Mechanism of Graben Formation*, edited by J. H. Hess, *Tectonophysics (Special Issue)*, 73, 91-104, 1981.

Forum

Flinn's Feature Fuels Forum

The enlightening note by Edward A. Flinn (Information transfer in verbal presentations at scientific meetings, *Eos*, 62, 179, 1981) brought to mind a somewhat similar discussion of this problem by the Scottish physicist, James Clerk Maxwell (1831-1879). Evidently, in response to a query from Professor Guthrie about the role of a physical society, which was something like an AGU meeting, he wrote in 1873 to W. G. Adams [Campbell and Gornett, 1984; p. 294]:

For the evolution of science by societies the main requisite is the perfect freedom of communication between each member and any one of the others who may act as a resister.

The gaseous condition is exemplified in the sciences, where the members rush about confusedly, and the only communication is during a collision, which in some instances may be prolonged by buttonholing.

The opposite condition, the crystalline, is shown in the lecture, where members sit in rows, while science flows in an interrupted stream from a source which we take as the origin. This is the condition of science.

Conduction takes place along a series of members seated round a dinner table, and fixed there for several hours, with flowers in the middle to prevent cross currents.

The condition most favorable to life is an intermediate plastic or colloidal condition where the order of business is (1) Greetings and confused talk; (2) A short communication from one who has something to say and to show; (3) Remarks on the communication addressed to the Chair, introducing matters irrelevant to the communication but interesting to the members; (4) This lets each member see who is interested in his special hobby, and who is likely to help him; and leads to (5) Confused conversation and examination of the objects on the table.

This pretty much describes an AGU meeting. Sleep is not explicitly mentioned, but it certainly occurs when (2) is not met, when upon (3) flourishes, (4) is blatantly satisfied, and (5) follows.

It is interesting, if not somewhat surprising, that even though our language has changed a great deal in 100 years, our problems have not.

B. D. Marsh
Earth and Planetary Sciences
Johns Hopkins University
Baltimore, Maryland

References

- Campbell, L., and W. Gornett, *The Life of James Clerk Maxwell*, 421 pp., Macmillan, London, 1984.

In his article, "Information Transfer in Verbal Presentations at Scientific Meetings" (*Eos*, 62, 179, 1981), E. A. Flinn raises some important issues. Unfortunately, the mathematical model is somewhat muddled. The internal inconsistency of the analysis became evident when I considered the conclusion that program chairpersons should stop the speaker at T_{max} . It is understandable that a former AGU annual meeting chairman should advocate such a time-conserving approach, but Flinn's own Figure 1 shows the knowledge absorption curve at a maximum slope at T_{max} . In other words, he advocates cutting the speaker off just as the audience is absorbing knowledge at a maximum rate. Surely the optimum cutoff time would be later.

The AVT is defined as the rate of knowledge absorption, so its decrease after T_{max} does not imply that T_{max} is the point of diminishing returns. The author's confusion at this point in the discussion is related to earlier ambiguity as to which quantities are rates and which are integrated amounts of knowledge. This problem would likely have been avoided if the basic rule of graphic presentation had been followed: "LABEL ALL AXES."

Suppose we rework the analysis, paying closer attention to the distinction between rates and integrated knowledge (Figure 1). 'Knowledge injection' is at a constant rate (at least in Flinn's model). The audience attention factor goes linearly from 1 at $t = 0$ to 0 at $t = T_{sleep}$, so the knowledge absorption rate drops linearly as shown in Figure 1a. Knowledge absorption is the integral of that rate, the quadratic shown in Figure 1b. This result is nothing like the curve shown by Flinn.

James N. Miller
Staff Scientist
Deep Sea Drilling
Scripps Inst. of Oceanography
La Jolla, California

Moving?

New address

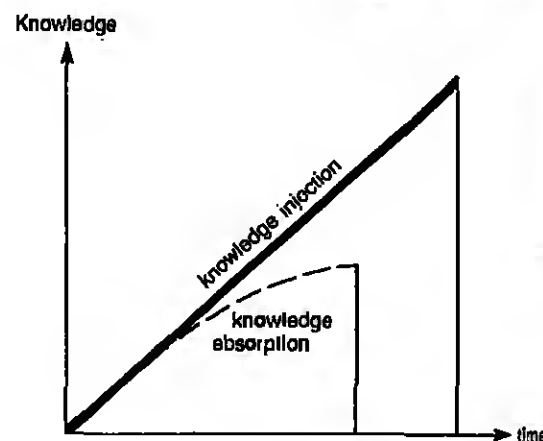
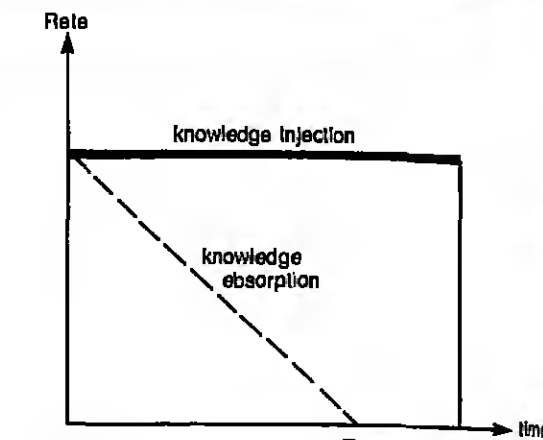


Fig. 1.

Flinn's AVT curve can be obtained only if the audience attention factor is applied directly to the integrated knowledge injection. That operation represents a model in which, as sleep approaches, the audience loses any knowledge it had gained earlier. Given that model, which may have some validity, the speaker is indeed best cut off at T_{sleep} when AVT is a maximum. Note, however, that in that case the AVT curve (not the integral) represents the knowledge absorption.

Richard Greenberg
NITP
Planetary Science Institute
Tucson, Arizona

Regarding Edward A. Flinn's discussion on information transfer in verbal presentations at scientific meetings (*Eos*, 62, 179, 1981), it occurred to me that a similar theoretical approach could be developed concerning (1) the effect of consecutive talks on an audience and (2) duration (number of days) meetings should be. Factors which have to be considered for (1) are (a) times when talks are given (low-priority talks being assigned to times early in mornings, late in evenings, or on the last day of a meeting), (b) the impact of coffee breaks, beer sessions, and jet lag on both speaker and audience (a different function for jet lag will exist for East and West Coast meetings), and (c) the effect of competitive sessions scheduled simultaneously at opposite ends of the conference center, or even, as commonly occurs, in different buildings. Regarding (2), external factors come into play such as (a) how the conference brought her family along? (b) median travel and per diem allowances surviving in proposals (an indication of function of national election results), and (c) the quality of local night life. Finally, Flinn devotes no attention to speaker strategies to maximize rate of knowledge injection. This can be done in two ways. The first is to vary the rate of knowledge injection at different points in the talk, and the second is to extend audience attention by interjection of humor, use of attractive slides, or causing excessive audio feedback with the microphone. The objective is to make the integrated AVT function more closely approach the integrated audience attention function.

News

Low-Gravity Materials Processing

The concept of growing crystals and of doing biological studies in the low-gravity space environment assumes that the absence of most, or all, of the influence of the earth's gravitational field on chemical and biological reactions is an important factor—at least important enough to justify costly testing.

One normally thinks of the effects of the gravitational field as being like the effects of any other field, electric or magnetic, on a thermodynamic process. In the simplest terms, there is work done as parts of a system travel through a gravitational field; a more exact statement would be that the free energy of a system, and hence the state of equilibrium, depends on the position within a gravitational field. The thermodynamic effects of the earth's gravitational field (the equation for the changes in free energy caused by differences in position within the field) are subtle but could be important in chemical and biological processes.

One of the new technologies that has emerged from the space program is the practical processing of materials in an environment where the effects of gravity are greatly reduced or eliminated. Early work done in the field has shown that low gravity eliminates, or greatly reduces, the effects of buoyancy, sedimentation, and convection on materials processes.

A technical exchange agreement—the first of its kind—has been signed between NASA and Deere and Company, Moline, Ill., to study the effects of low gravity on various iron alloys. Under the agreement, NASA's Marshall Space Flight Center, Huntsville, Ala., will use low-g facilities available to it—including drop tubes, KC-135 and F-104 aircraft, and possibly sounding rockets—to substantially reduce gravity conditions during alloy solidification experiments. Deere and Company will do sample preparation, ground-based characterization of the samples, extensive sample analyses, and data reduction, as well as thermal characterization of the furnace used for melting and solidifying the samples. The experiments and investigations performed under the agreement could eventually lead to Deere conducting research aboard a future space shuttle mission.

Data will be shared between the two parties. NASA and Deere personnel will visit each other's facilities and participate in experiment planning and analyses. The agreement is expected to be in effect for 1 year, but it may be extended if needed.

NASA currently is carrying out low-g processing in such areas as alloy solidification, crystal growth, biological separations, and chemical and fluid physics. NASA's Materials Processing in Space program has developed a variety of ground-based and flight facilities and experiment hardware to utilize the low-gravity environment and has invited industry to participate in joint investigations and projects.

In this concept for involving industry, the federal government and a private company agree to be responsible for specific portions of the research effort, and no funds are transferred between parties. The allocation of rights to resulting inventions and data is subject to negotiation between the parties for each effort undertaken.—PMB

WINDSAT: Space Wind Sensor to be Tested

A new wind sensor system is being tested on a mesa north of Boulder, Colo., by a team led by Freeman Hall of the Wave Propagation Laboratory. The tests are successful, a more advanced version of the system may be tried out later in this decade on the Space Shuttle. The system's ultimate destiny would be aboard a proposed satellite called WINDSAT.

Global wind measurements are a vital but missing link in efforts to improve long-range weather forecasting. Present upper-air wind measurements, mostly by instrumented balloons, are too limited, and there is a need for an extended method.

The new wind sensing system is built around a laser radar that can gauge the speed with which winds are moving toward or away from it. Measurements come from the frequency shift of infrared beams reflected from wind-borne particles.

The system envisioned for WINDSAT would be able to measure the winds in layers spaced 1 km apart. The present version, in which the laser beam is projected by a mirror 25 cm in diameter, has a range of 20 km. The satellite version would have a mirror 14 m in diameter and would be powerful enough to scan hundreds of kilometers. [Source: NDAA] ss

B.S. in P.E. = \$30K/Year

Earth sciences graduates can "... [look] forward to long lines of would-be employers who will try to tempt [them] with high salaries," according to a report describing a new survey by the College Placement Council (*Industrial Research and Development*, July 1981). This survey of the job market reports that graduates with the bachelor's degree in the earth and physical sciences have been starting employment at an average salary of approximately \$22,000 per year. This figure amounts to an 18% increase over the average starting salary for the same groups a year ago. Another important result is that some starting salaries for petroleum engineers (B.S. in P.E.) are upward of \$30,000 per year, which though not at all unusual, was the top starting salary group for 1981 college graduates. *Industrial Research and Development* points out that liberal arts gradu-

ates consider themselves to be fortunate if offered starting salaries of \$12,000 per year.

Petroleum engineers, and engineers in general, traditionally get the best offers; the increase in earth scientists' salaries is a notable exception this year. Many other fields are oversubscribed and overemployed. An example of a field that is now and has been in the past highly popular among employers is the field of computer science. The average starting salary this spring for computer majors was approximately \$20,000 per year, but this level constituted only a relatively small increase over last year's starting salary.

As a group, engineers simply do better than any other group right out of college. As quoted from the College Placement Council's report (Spring, 1981), "63% of all the job offers at 181 colleges and universities surveyed by the Council went to engineers." Note though that the engineering majors from those universities made up only about 7% of the graduates. ss

Nation's Water Picture Brightens

The nation's streams took a strong upturn during June, showing good recovery from the persistent dry trend of the previous months, although scattered pockets of below-normal flow were reported in parts of the Southeast and the West, according to a month-end check by the U.S. Geological Survey.

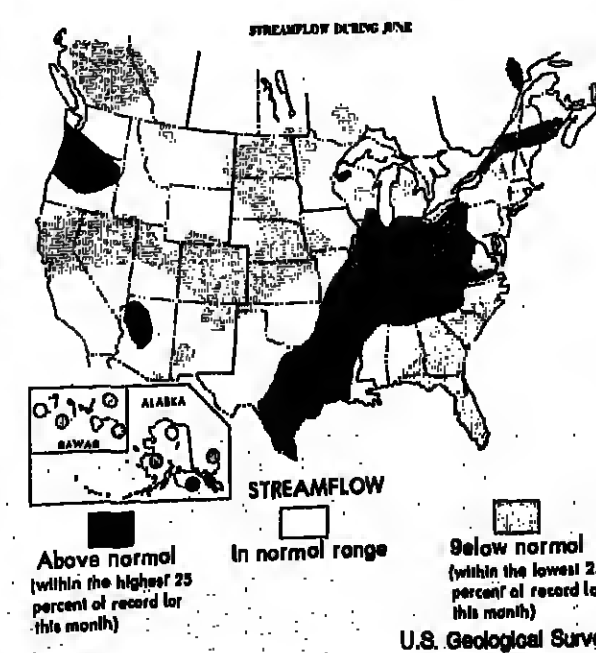
USGS hydrologists said that 30% of the 165 key index stations reporting across the country in June showed well below normal streamflow (within the lowest 25% of record), a decided upward trend from May, when half of the index stations reported below-normal streamflow. Below-normal flows were reported in parts of 27 states during June, down from the 31 states that reported low flows in May.

The Southeast is, however, still severely affected by the long months of dry conditions. A band of persistent low flow exists from the Carolinas south to Florida and west through Georgia and Alabama. Flows on some streams in South Carolina have been in the lowest 25% of record now for six straight months. That is, 75% of the time, streamflow will be equalled or exceeded. All six of the key index stations in Florida reported below normal flows for June, the second consecutive month that all six stations have been below normal.

Strong recovery was noted from the Great Lakes Region south through Kentucky, Tennessee, Arkansas, and most of eastern Texas, where streamflow was within the highest 25% of record for June.

Reflecting the general national improvement in June streamflow conditions, combined flow of the "Big Five" rivers (Mississippi, Columbia, St. Lawrence, Ohio, and Missouri) averaged 1281 billion gallons a day (bgd), 30% above normal and the first time in 7 months that the combined flow of the rivers has been above normal.

Individual flows of the Big Five for June: Mississippi River near Vicksburg, Miss., 573 bgd, 50% above normal and a 48% increase from May; Columbia River at The Dalles, Ore., 302 bgd, 2% below normal but 20% above last month; St. Lawrence River near Massena, N.Y., 164 bgd, 3% below normal but 2% above last month; Ohio River at Louisville, Ky., 147 bgd, 270% above normal and 32% above May; and the Missouri River at Hermann, Mo., 75 bgd, 6% above normal and 8% above May. (Photo credit: U.S. Geological Survey, Department of the Interior.) ss



Keyworth stressed that the Administration's proposed budget provides funding needed for support of the "hard" sciences. He made the point that this country can no longer afford to maintain a leadership role in the broad spectrum of sciences, but instead must be selective. He appeared to divide the federal government's future funding support in science between the areas of pertinent and promising science and the disciplines that support technology, both industrial and military. The "pertinence" was in relation to prevailing national requirements. The "promise" was in reference to his conviction that the "payoff" of basic research could not be expected for upwards of 10 years after a grant had been awarded.

Like his predecessor in the directorship of the Office of Science and Technology Policy, Keyworth sees his role not so much as an advocate of the sciences, who has the President's ear, but as more of an advisor, a setter of priorities.

Although the main thrust of Keyworth's speech was that the country's preeminence in scientific research was to be restricted to areas of science selected after careful review, he did not indicate support of any standard less than one of excellence. Some fields would simply have to be abandoned, but those supported would have to be of convincingly high priority. He gave the widely held opinion that pumping more and more funds into an area of research, even one of high priority, is a process that succumbs, eventually, to the law of diminishing returns. Support, therefore, is to be granted to essential programs, and even then, to a limited level.—PMB

Geophysicist Obituary

J. M. Burgers, 86, died on June 7. He joined AGU in 1956.

New Publications

Weather Modification by Cloud Seeding

A. S. Dennis, Academic, New York, xv + 267 pp., 1980, \$29.50.

Reviewed by Charles L. Hosler

This book accomplishes its stated purpose of providing information on cloud seeding to upperclassmen or graduates of university programs in the physical sciences or engineering, and I would recommend it to them as a quick and painless way to become conversant with what cloud seeding is all about. The book may discourage an even larger audience of nonchalcitically oriented cloud-seeding enthusiasts or seekers of knowledge by the omission of a paragraph or two of a more elementary and descriptive treatment of processes such as nucleation, cloud formation, and precipitation formation at the beginning of the chapters treating those topics. The nine chapters cover an Introduction, which includes a brief history and context for cloud seeding; 'Atmospheric Aerosols'; 'Formation of Clouds and Precipitation'; 'Concepts and Models for Cloud Modification'; 'Generation and Application of Silver Iodide Crystals and Other Seeding Agents'; 'Statistical Evaluation of the Results of Cloud Seeding'; 'The Modification of Fog, Snow, and Rain'; 'Suppression of Weather Hazards'; and 'Impact of Weather Modification on Society.' All of these chapters are brief and to the point. The elaboration that many of those familiar with the topics treated might seek or feel necessary for completeness would have turned the book into something the author did not intend it to be.

The readers seeking a quick answer as to whether or not cloud seeding is the answer to their concern in a situation where they need rain or want to prevent or promote some weather event will be disappointed. There is no formula to apply or table or graph that will help to decide. This is as it should be because the answers are not that easy to determine, even by the experts. The reader seeking that information will probably conclude that he needs expert advice and that also is as it should be. The general physical knowledge and the information on the potential for weather modification through cloud seeding available in this book will place the person seeking advice in a position to at least ask the right questions.

There is a persistent tendency on the part of nonmeteorologists, supported by some early claims by cloud seeders, to presume that weather over the whole country or even global weather can be altered by local or regional seeding. Thus, the reviewer would have preferred a stronger case be made for the lack of a physical basis for expecting cloud seeding to effect the overall development of wave cyclones and large-scale synoptic features. The casual reader may miss the brief treatment stating that we have no hypotheses to support this type of modification. This should have been backed up by the reasons one would not expect such modification.

This is a useful book by a knowledgeable author that should find its way into the bookshelves of college teachers and technically oriented users or potential users of cloud seeding. For those interested in extensive examination of the subject, it is a good starting point.

Charles L. Hosler is with the Department of Meteorology, Penn State University, University Park, Pennsylvania.

Geodesy

W. Torge, *Walter de Gruyter*, New York, xi + 254 pp., 1980, DM 48.

Reviewed by K. P. Schwarz

The book is a translation of a well-known German textbook on geodesy, which has been widely used since its publication in 1975. On occasion of this translation it has been revised and thus includes developments to about 1978.

The book is subdivided into the following sections: Introduction, The Gravity Field of the Earth, Geodetic Reference Systems, Methods of Measurement in Geodesy, Global Geodesy, and Geodetic Surveying.

The introductory section reviews briefly the definition, historical development, and organizational structure of geodesy. The second section discusses the components of the gravity potential, level surfaces, and plumb lines, the representation of the geopotential by spherical harmonics, and time variations of the gravity field. The third section introduces global and local astronomical and terrestrial frames and relates them to the reference surfaces defined by the actual and the normal gravity field. The fourth section treats astronomical, satellite, and terrestrial positioning methods as well as the measurement of absolute and relative gravity. The fifth section deals with the problem of determining a global representation of the gravity field by astrogeodetic,

gravimetric, satellite, or combination methods and discusses some implications for the structure and dynamics of the earth. The last section, somewhat of a misnomer, gives an introduction into horizontal, vertical, and gravity networks.

The strength of Torge's *Geodesy* is its conciseness and good organization. The whole material is presented on 254 pages with sections 4 and 5 taking about two thirds of the space. The price for this conciseness is the absence of detailed derivations. In general, only major steps in the development are given, and often one has to be content with the final formulae. The author has added, however, an extensive bibliography and has cross referenced the text with great care. The interested reader can thus go back to source information, although a knowledge of German besides English is mandatory in this case. The presentation shows a good balance between the mathematical formulation of a problem and its descriptive explanation and thus provides the reader with a clear picture of the fundamentals and the techniques presently used in geodesy.

In summary, the book presents the body of geodetic knowledge in a well-organized form and formulates the main problems and solution approaches in a concise and careful manner. It is therefore welcome in a field where good textbooks do not abound. It is recommended as an undergraduate text for geodesy courses but will also serve the geodesist who wants an up-to-date presentation of the field without a detailed discussion of current research problems.

The excellent quality of printing and graphics reproduction as well as the smooth translation of the original text add to the attractiveness of the book.

K. P. Schwarz is with the Division of Surveying Engineering, University of Calgary, Calgary, Alberta, Canada.

New Listings

Items listed in New Publications can be ordered directly from the publisher; they are not available through AGU.

- Space Science Comes of Age: Perspectives in the History of the Space Sciences*, P. A. Hanle, V. D. Chamberlain (Eds.), Smithsonian Institution Press, Washington, D.C., xiii + 194 pp., 1981, \$12.50 (paper), \$22.50 (cloth).
- Statistical Treatment of Environmental Isotopes Data in Precipitation*, Tech. Rep. Ser. 206, International Atomic Energy Agency, Vienna, Austria, xx + 255 pp., 1981.
- The Economics of Irrigation*, I. Carruthers and C. Clark, Liverpool University Press, Liverpool, England, xviii + 200 pp., 1981, £20.00.
- The Inaccessible Earth*, G. C. Brown and A. E. Mussett, Allen & Unwin Inc., Winchester, Massachusetts, xii + 226 pp., 1981, \$41.00 (cloth), \$22.50 (paper).
- The Magnetotelluric Sounding Method*, A. A. Kaufman and G. V. Keller (Eds.), Elsevier, New York, xiv + 596 pp., 1981, \$144.00.

AGU Awards

The Twentieth Presentation of the
James B. Macelwane Award
to
Ronald J. Prinn, David Southwood,
and Donald J. Weidner

In recognition of significant contributions to the geophysical sciences by a young scientist of outstanding ability



Ronald G. Prinn



David Southwood



Donald J. Weidner

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Visiting Scientist Position: The Joint Institute for the Study of the Atmosphere and Ocean, University of Washington. Visiting scientists with background in atmospheric sciences or physical oceanography and interests in dynamical and/or geochemical aspects of climate variability. Term of appointment, one (1) year, renewable for a second year subject to the approval of the Council. Closing date: September 15, 1981. Send curriculum vitae and a brief research prospectus to: Director, JISAO, c/o Department of Atmospheric Sciences, AK-40, University of Washington, Seattle, WA 98195.

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Atmospheric Scientist Group Head. Senior scientist position available immediately at the NASA's Arecibo Observatory. The successful applicant will be appointed as Head of the Atmospheric Sciences Group and will be expected to lead that group and to perform independent research using the Arecibo facilities. A Ph.D. degree in atmospheric or physical sciences or radar engineering and a record of solid research accomplishments are required. Experience with radar studies of the strato-

sphere, mesosphere, and ionosphere or with HF modifications of the ionosphere is desirable. Salary open. Please send resume and names of at least three references to: Dr. Harold O. Gier, Jr., Director, Arecibo Observatory, Space Sciences Building, Cornell University, Ithaca, New York 14853.

NAAC Cornell University ora EOE/AEE.

Physicist Oceanographer. A postdoctoral research position in physical oceanography is available at the University of North Carolina at Chapel Hill, to begin as early as August 1981. Ph.D. with background and interests in mesoscale Gulf Stream dynamics, geophysical fluid dynamics, or ocean acoustics are encouraged to apply. Initial appointment will be for one year with a possible continuation through a maximum of three years.

Please send vitae and the names of three references to Professor John M. Bane, Marine Sciences Program, 12-5 Venable Hall OSA, University of North Carolina, Chapel Hill, North Carolina 27514. The University of North Carolina is an affirmative action equal opportunity employer.

University of Hawaii Faculty Positions. The Department of Geology and Geophysics and the Hawaii Institute of Geophysics have openings for the 1981-1982 academic year. Rank is open dependent on qualifications. We are seeking persons who will participate in our teaching and research program in any of the following areas: (1) structural geology and marine tectonics; (2) hydrology and engineering geology; (3) marine sedimentology, magnetism, and gravity. To apply send a letter of interest, a current vita and 3 letters of reference to: Dr. S. O. Schlegel, Chairman, Department of Geology and Geophysics, University of Hawaii, 2255 Correa Road, Honolulu, Hawaii 96822 (808-948-7828), or Dr. C. E. Helsley, Director, Hawaii Institute of Geophysics, same address (808-948-6760). Open until filled.

The University of Hawaii is an affirmative action and equal opportunity employer.

Research Associate in Physical Oceanography. Applications invited for a 12 month position as Research Associate in the School of Oceanography, Oregon State University, Ph.D. in physical sciences. Must have demonstrated ability to analyze oceanographic data, preferably data from small-scale turbulence experiments.

Appointee will be expected to cooperate in the analysis of oceanic microstructure data. Salary: \$22,000. Submit application and names of three references by 31 August 1981 to: Douglas R. Caldwell, School of Oceanography, Oregon State University, Corvallis, Oregon 97331. OSU is an affirmative action equal opportunity employer.

Polar Oceanographer/Sea Ice Dynamist. A position is available under the International Personnel Act of 1970 for persons now employed in Statistical government or in colleges and universities. This position is located within the Oceanic Processes Branch of the Environmental Observation Division of the Office of Space and Terrestrial Applications, NASA Headquarters. The position is for one year, with the possibility for renewal for an additional year. Pay will be at a level commensurate with experience, and will be established after a review of qualifications.

Candidates must have been employed by the university in a permanent position for at least 80 days or be a career employee of a State or local government. Candidates must also meet the Federal qualification standards for the position. These are as follows: a degree in an appropriate field of science, plus three years of progressively responsible experience in duties related to the position. This individual will be responsible for planning, developing, and implementing a scientific research program in satellite remote sensing of oceanic processes in polar regions. A background in polar oceanography, sea ice dynamics, or a closely-related field is required; experience in remote sensing, although desirable, is not essential. A Ph.D. or equivalent training and experience is mandatory.

Interested parties should send a current resume to NASA Headquarters, Attn: Mrs. Catharine Zegowitz, Code EPM-3, Washington, D.C. 20546. Selection for this position will be made from otherwise eligible candidates without discrimination for any nonmerit reason such as race, color, religion, sex, national origin, politics, marital status, physical handicap, age, membership or nonmembership in an employee organization, or personal favoritism.

Electron Microprobe Technical Specialist/Geological Sciences. The department of Geological Sciences, University of Colorado, Boulder, seeks a person who will assume responsibility for the department's electron microprobe laboratory. Duties will include day-to-day operation of our MAC 400 microprobe equipped with a KEVEY EOS system, instruction of new operators, maintenance of the microprobe as well as other X-ray equipment within the department, microprobe software and hardware development, and participation in research projects involving silicates, sulfides and oxides mineralogy. The job requires either a degree in electronic or electrical engineering, or two years of technical experience utilizing electronic instrumentation associated with an electron column instrument. An individual with an M.S. degree in Geology and microprobe experience will be considered highly desirable. Salary ranges from \$20,000-\$25,000, depending on experience. Please send, by August 15, letter of application and resume to Bruce Badger, Personnel Department, University of Colorado, 1511 University Avenue, Boulder, CO 80309. The University of Colorado is an equal opportunity affirmative action employer.

Acoustical Physicist. Physics and Chemistry Department of Naval Postgraduate School (NPS), Monterey, California, seeks applicants for tenured-track position at assistant or associate professor level, physicist who has experience and interest in teaching and research in area of acoustics. Primary mission of NPS is advanced education of Naval Officers. Department offers M.S. and Ph.D. degrees in Physics and Engineering Acoustics with major emphasis on Master's degree programs. Most acoustics teaching is at senior and graduate level with concentration in underwater acoustics. Candidates must have Ph.D., be effective teacher and be interested in and capable of engaging in research. Current acoustics research areas: ocean acoustics including propagation, ambient noise, scattering and diffraction; propagation in tapered waveguides; acoustic imaging; signal processing and non-linear acoustics. Send resume and references to Prof. O. S. Wilson, Department of Physics and Chemistry, Naval Postgraduate School, Monterey, CA 93940.

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Geohydrology/Geochemistry/Economic Geology. Applications are invited for a one year appointment effective August 15, 1981 to teach undergraduate courses in introductory geology and other geohydrology, geochemistry, or economic geology. Ph.D. preferred but will consider ABD. The position will be reappointed in September 1981 as a tenure track slot at the assistant professor level with teaching and research duties about \$50,000. Applications including resume and names of three references should be sent to W. O. Gosnell, Jr., Department of Geography-Geology, University of Nebraska at Omaha, Omaha NE 68182.

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STUDENT OPPORTUNITIES

Metereology and Physical Oceanography Assistantships. Research assistantships for graduate students in meteorology and physical oceanography are available from The Florida State University. Research topics may cover atmospheric dynamics, physical meteorology, synoptic meteorology, climatology, numerical weather prediction, physical oceanography, chemical oceanography, ocean modeling, satellite oceanography and geophysical fluid dynamics. Appointments are full-time and offer salaries up to \$10,500 per year. Beginning graduate students may be offered salaries as low as \$7,200. Students with undergraduate degrees in physics, chemistry, mathematics, statistics, meteorology, oceanography and engineering are encouraged to apply. Additional information may be obtained from Dr. James J. O'Brien, Massachusetts Air-Sea Interaction Group, The Florida State University, Tallahassee, Florida, 32306.

Citation to Prinn

Mr. President, ladies and gentlemen: We are honoring tonight a young scientist who combines an unusually broad knowledge of the chemistry and dynamics of planetary atmospheres with a healthy skepticism regarding established dogma and a marvelous ability to shrug off the displeasure of established dogmatists.

Ron Prinn's theoretical research has significantly influenced our understanding of the terrestrial stratosphere as well as the atmospheres of Venus and Jupiter. Since 1980, when he joined the Department of Meteorology at Massachusetts Institute of Technology, he has been a leading participant in collaborative efforts to develop numerical models of the stratosphere combining comprehensive chemistry with realistic dynamics. Such models have been a rich source of controversy in our continuing efforts to predict men's potential impact on the ozone layer. Prinn's work on the chemistry of sulfur gases in the atmosphere of Venus, published in 1973 and 1975, foreshadowed the explosive growth of interest in the sulfur chemistry of the terrestrial atmosphere. By delimiting conditions for the predominance of either sulfur or sulfuric acid in the clouds of Venus, his work provided a basis for the interpretation of Pioneer Venus data. It was Prinn who suggested that the spectacular dark markings on ultraviolet images of Venus are caused by sulfur. More recently he has discussed the contribution of phosphorus to the color of the Great Red Spot on Jupiter. Nor forsaking the mother planet, he is currently engaged in efforts to determine from field measurements whether there is any truth in the well-established theory that from methyl chloroform, and nitrous oxide are chemically inert in the troposphere.

Mr. President, it is a privilege and pleasure to present Ronald G. Prinn for the James B. Macelwane Award.

James C. G. Walker and
Ralph J. Cicerone

Acceptance

Thank you Jim for your very kind citation. I am flattered to be joining the distinguished list of previous recipients of the Macelwane Award. It is also a delight to be related to as young again. Back when I was really young, I regarded people over 30 as definitely middle-aged. My work has required me to delve into more than one area of specialization. Fortunately, as I have wandered through the disciplines of meteorology, atmospheric chemistry, and planetary science, I have been treated with mercy by the professionals in these areas. Perhaps this is because the meteorologists think I am an atmospheric chemist, the atmospheric chemists presume I am a planetary scientist, and the planetary scientists see that I am in a meteorology department and my true profession must therefore be weather forecasting. However, I see that the awards committee contains representatives from all three of these disciplines, so I must be immune from such a rib at least for tonight.

Any recognition coming my way this evening must in fact be shared with a number of unselfish friends, collaborators, and colleagues. Let me take this opportunity to mention a few of these people who have influenced my directions in beneficial ways. John Lewis managed to entice me away from a career in molecular quantum mechanics and showed me that speculation can be an occasionally respectable vocation. Norman Phillips successfully guided me into the then largely alien environment of meteorology and was instrumental in the formulation stages of the stratospheric model, which Jim has mentioned. My collaborators in this modeling work, Fred Alaya and Derek Connolly, have done a large part of the day-to-day work on the model and, in addition, are my collaborators in the fluorocarbon lifetime experiment, which has also been mentioned. Don Hunten has been burdened with refereeing an unseemly number of my publications and has been blunt when necessary and encouraging when needed. Gerry Wasserman showed me by example that scientists should be actively involved in the occasionally thankless task of guiding and advancing their fields, and not merely reap the benefits of others' efforts in these endeavors.

A \$10,000 contribution was approved as seed money for planning a series of films in the geophysical sciences. The National Academy of Sciences is investigating the possibility of producing a new series along the lines of those produced after the IGY. If the films go into production, they will be listed among the sponsoring organizations. The annual business meeting of the Union was held immediately after the adjournment of the Council meeting.

The citation of my work in planetary atmospheres carries particular pleasure. It has frankly been a joyful task to explore the photochemistry of apparently exotic atmospheric species such as hydrogen chloride, carbonyl sulfide, phosphine, and thiozone. It is also my belief that research in planetary atmospheres can and has had important implications for our own atmosphere, in addition to having its own intrinsic fascination.

I sincerely thank President J. Tuzo Wilson and the American Geophysical Union, and in particular the Macelwane Awards Committee, chaired by Gerry Wasserman, for this unexpected yet gladly accepted award.

Ronald G. Prinn

Citation to Southwood

It is indeed an honor and a pleasure for me this evening to introduce to you one of the recipients of the Macelwane award, Dr. D. J. Southwood of Imperial College, London, England. This award is presented annually by the American Geophysical Union for outstanding contributions by a young scientist. It is very fitting that David be selected this year.

David, a British citizen, was born in Torquay, England, in 1945. Mothers of small children take heart. According to David's mother he did not utter his first words until after the age of two. However, he has not been at a loss for words since. Shortly thereafter he entered Queen Mary College in London. Later he became a postgraduate student under Professor J. W. Dungey at Imperial College, under whom he wrote a thesis entitled "Theoretical Studies of ULF Waves in the Magnetosphere," receiving his Ph.D. in 1964. Shortly after graduation, David spent a year at UCLA, continuing his work on magnetic pulsations and, on the side, leeching me much of what I know about the underlying physics of the magnetosphere. After his stay at UCLA he returned to Imperial College as a lecturer, but David soon got itchy feet again. However, since then he has usually satisfied his urge to travel by almost annual summer visits to the U.S. We at UCLA have been fortunate enough to have him join us five times in the last 10 years.

David's initial contribution to magnetospheric physics was a theoretical and experimental investigation of the Kelvin-Helmholtz instability at the magnetopause. He later looked at wave-particle resonances within the magnetosphere and their effects on cross-L diffusion. Together with his student, W. J. Hughes, he examined the effect of the ionosphere on magnetic pulsations and brought order and comprehension to an otherwise confused situation. Together with Margaret Kivelson of UCLA he examined the effects of electric fields on magnetospheric particle motion and, in particular, aided in the understanding of the physics of particle injection into the magnetosphere. Most recently he has been putting order into our understanding of the way in which the Geleian satellite to interact with the Jovian magnetosphere.

I can't help remarking as I did here several years ago (*Eos*, 58, 872-873, 1977) that having a name in the latter half of the alphabet helps one to win the Macelwane award. However, David's deceptively simple name has also led him on occasion to gain less credit than he deserves. Recently, for example, he was referenced seven times in a paper as Southward (*Geophysical Research Letters*, 7, 881-884, 1980). On another occasion a proposal was sent into NSF with his name on the cover written as Smolwood. Perhaps tonight's ceremonies will help us remember David's real last name.

I would like to close this introduction by reading the citation prepared by the awards committee [and] which very accurately summarizes David's contributions to date.

Over the last 14 years, David Southwood has substantially advanced the application of magnetohydrodynamic theory to space plasmas and, particularly, to the earth's magnetosphere. His Ph.D. thesis on the Kelvin-Helmholtz instability at the boundary of the magnetosphere was a landmark in the field. Over the last decade, he has become perhaps the leading expert on the theory of magnetohydrodynamic waves in the magnetosphere. He has made a substantial contribution to the

theories of magnetic-field-line resonance, of the generation of magnetic pulsations by the Kelvin-Helmholtz instability, and of the influence of the ionosphere as a boundary condition on magnetohydrodynamic waves. In general, his research was a major factor in the theoretical developments needed for the interpretation of the last decade's increasingly sophisticated space- and ground-based observations of geomagnetic micropulsations. He has also worked actively and productively in other areas of space plasma physics. By means of clever but simple calculations, he has contributed significantly to the theory of large-scale plasma motions in the earth's magnetosphere and, particularly, to the understanding of the transport of particles into the ring current and the Van Allen belts. This work on the earth's magnetosphere, and also his very recent work on the interaction of the Jovian magnetosphere, has been characterized by creativity, by clear intuition, by deep understanding of physics, and by the precious ability to bring theory into effective contact with observations.

Christopher T. Russell

Acceptance

I am very honored to receive this award, and in spite of the citation you have just heard I think my ability has been to be in the right places and to work with the right people.

At Imperial College I work with two close colleagues, Jim Dungey and Stan Cowley, without whom I would not be here. I have worked with Jim since my postgraduate days, and one thing I am indebted to him for is converting me from a malleable malleable to a physicist, something I have not regretted.

There are large numbers of people I have worked with at UCLA. I shall single out Margaret Kivelson for mention. It is good to work with a clever colleague, even better if she has shared attitudes and complementary skills. I have also noticed she is charming and attractive and a stickler for correct use of grammar.

I have one unusual working relationship. My mother works in the same group as me. We have more or less worked out who works for whom. Though widowed when I was quite young, she successfully raised me and my brother. Late in life she started a technical education only to end up working in the same place as both her sons.

Another close relative to whom I owe a great deal is my wife, Sue, who has divided her attention between activities such as raising our three children, Anna, Michael, and Peter, and ministering to me more than I deserve, but also including setting up her own business and involvement in a variety of outside interests.

There are lots of other people who should share some of my glory. I cannot name them all, but I am aware that a very large fraction are American. Probably all Europeans speculate at some time on the American they might have been. I worked here enough to know, and I have had a fair immersion in American values. I am not original in pointing out values are often hilariously the opposite of my native British ones. Sincerity (or boring seriousness) is an American virtue. Cynicism (or flippancy insincerity) is a prized British social skill. I am busy cultivating a happy schizophrenia where I accept both sides. In particular I like American enthusiasm for hard work and your optimism about change. These latter attitudes make for a dynamism in U.S. science I have always found exciting. Thanks to you all for this.

Finally, let me say something on the virtues of travel. It broadens the mind, challenges the digestion, cemented collaboration, helps international understanding but, unfortunately, costs money. I would like to thank the several funding agencies and grant-awarding bodies in the United Kingdom, United States, and elsewhere who have helped me to travel. Was it not a scientist who said, "I have traveled further than most. It is because I have been the holder of grants?"

David Southwood

Citation to Weidner

Mr. President, ladies and gentlemen: I have the pleasure of introducing Donald J. Weidner. He has been a pioneer in the development of the Brillouin scattering method of measuring elastic moduli of minerals. Shortly after joining the faculty of the Department of Earth and Space Sciences at Stony Brook, New York, in 1972, he became interested in Brillouin scattering and alerted to build a research lab for the application of Brillouin scattering to the investigation of elastic properties of minerals. He recognized the value of the technique in making measurements on very small samples, a capability that makes it particularly attractive for examining quenched high-pressure phases and other examples that are available in very small sizes. In the short time since he established his lab, he and his colleagues and students have made measurements on many important rock-forming minerals and have reported the results in a number of excellent professional papers. In many cases the measurements were made on tiny specimens which are barely visible to the human eye and whose elastic properties could not have been measured in any other way. Concurrent with this work, he has continued his studies in seismology as well as in [his] theoretical investigations [into] the elastic properties of crystals.

The development of a new technique and its application to the acquisition of data that would otherwise have been unobtainable is a big challenge. The success of Donald J. Weidner in this endeavor attests to his exceptional abilities as a scientist.

AGU

Highlights: Spring Council Meeting

Council members present at the May 24, 1981, meeting were Keith Aki, Steven Burgos (for Jim Willis), Peter S. Englehorn, E. R. Engdahl, Charles E. Helsley, James R. Heitzler, Carl Kisslinger, Leslie H. Merdith, Chris N. K. Moores, Norman F. Ness, Marcia M. Neugebauer, James J. O'Brien, Richard Rapp, Carl Sagen, James C. Sevege, Joseph V. Smith, Fred Spilhaus, Donald L. Turcotte, James A. Van Allen, J. Tuzo Wilson, and Jay Winston (for Eimer R. Reiter until his arrival at 6:50 P.M.). David Strongway, representing the Canadian Geophysical Union, and Peter Steinhauser, representing the European Geophysical Society, were special observers at the meeting. Council meetings are open, and a number of section secretaries, committee chairmen, journal editors, and other members attended. The following major actions were adopted by the Council:

The experiment of publishing oceanography and lower-

atmosphere papers in JGR Green Issues alternates to those containing upper-atmosphere papers will be continued through 1982. From preliminary indications the experiment seems to be working, but a full year of data, including a renewal cycle, is needed to assess the success of the experiment. Final decision will be made prior to the 1983 dues notices.

Publication of a bimonthly journal devoted to tectonics will begin in 1982. Because there will be no page charges, the journal will be strictly limited as to the number of pages copy. The outline of this proposal was given in the editorial column of the April 7 issue of *Eos*.

The AGU Congressional Science Fellowship was continued for 1982-1983. In discussion of this issue it was noted that congressional staffing tends not to include scientists, and therefore science is not represented in the congressional committees. AGU participation in the AAAS Congressional Fellows Program.

Participation in the AGU (American Geological Institute) Minority Scholarship Program was continued through the 1982-1983 school year. The program has attracted many good applicants. Applicants funded by the AGU contribution are designated AGU scholars.

The elections accepted the responsibility for accepting nominations for AGU fellows. It was thought that in the past applicants will be considered first by those most familiar with the field.

Touche Rose and Company was selected as AGU's auditors for 1981.

A \$10,000 contribution was approved as seed money for planning a series of films in the geophysical sciences. The National Academy of Sciences is investigating the possibility of producing a new series along the lines of those produced after the IGY. If the films go into production, they will be listed among the sponsoring organizations. The annual business meeting of the Union was held immediately after the adjournment of the Council meeting.

Donald Waldner is not only an accomplished scientist but a person who has already guided and inspired a number of promising younger scientists to begin careers in seismology and solid state geophysics. Mr. President and officers of the Union, I present Donald J. Waldner for presentation of the 1981 Macelwane Award.

Thomas J. Ahrens

Acceptance

Thank you Tom for your kind remarks. I also thank the American Geophysical Union for honoring me with this award.

This award is particularly gratifying to me inasmuch as it relates to a few aspects of my life. Every morning when I confront the mirror I discover that my forehead has made yet another advance on my hairline. Even worse, those teller than I tell me that my forehead is about to conquer the very top of my head. I find my joints groaning as I do simple tasks. Graduate students are now hardly trouncing me at squash. I look across the campus and ask who are these children, only to find out that they are the graduating class. With all of these observations at hand, I cherish the part of the Macelwane citation which reads "young scientist."

I am also very grateful by the recognition of my research given by this award. As I am sure is true of most of this audience, there have been many hard hours late at night, many frustrations, and a few successes. There are times when we wonder if anyone cares about what we're doing. There are times when we question if we should be doing something else. The monetary rewards associated with a faculty position are traditionally small. It is under those circumstances that an award such as this one serves to renew one's vigor.

But, in the final analysis we realize that we do not pursue science for the awards or personal recognition. As the physicist, mathematician, philosopher Henri Poincaré once said, "The scientist does not study nature because it is useful; he studies it because he delights in it, and he delights in it because it is beautiful." Clearly we hope that our results may be useful to others, but it is the beauty of nature and the excitement of discovery that drives us and not the pursuit of awards.

It is Isaac Newton 'stood on the shoulders of giants,' I stand as a dwarf among giants. Many people have helped me personally and professionally. For most of my life, Deborah, who has cheerfully helped and supported me both in the easy times as well as the hard ones. My brother Jerry showed me by example how a scientist should think. My advisor, Kai Aki, nurtured me at a young age and aided my development. Graduate students at Stony Brook both contributed to my research program and provided water from the fountain of youth. In particular, I wish to acknowledge Michael Vaughan, Alan Kalke, Jay Bass, and Andy Au. The Institution of Stony Brook and my colleagues in the Department of Earth and Space Sciences have provided an atmosphere of stimulation, collaboration, and when necessary, equipment that has allowed my research program to advance. The National Science Foundation has been generous in their support. To all of these I am grateful.

Since learning that I was to receive this award I have, on many occasions, considered refusing it. One such time was when I had to prepare this speech. Awards such as this come with many liabilities. University administrations often require recognition of achievement with administrative ability; the result being a quantum increase in university committee work. One's colleagues suddenly become more critical of the research program and question why the AGU committee ever chose this one to receive an award. More importantly, however, such an award brings more responsibility. The recipients must now live up to the honor that they receive. I am awestruck when I read the names of previous recipients of the Macelwane award. The tradition of accomplishment that they have set since receiving this award is intimidating, and living up to this tradition is truly a great challenge. I am honored to have my name listed along with theirs, and in the spirit of accepting this challenge, I gratefully accept the Macelwane award.

Donald J. Waldner

Sponsors of 1981 New Members

Two hundred fifty-nine new members were elected between May 1 and June 30, 1981. The AGU members who sponsored them are listed below.

Three Members: Alan R. Bundy, Richard L. Carlson, Neville L. Carter, H. W. Dosso, R. E. Horita, Garard Lachapelle, Peter J. Maroulis, Lawrence A. Taylor.

Two Members: Bruce A. Bolt, Kevin Burke, Chantung Chan, David M. Christo, Ralph J. Cicerone, Jacques W. Delleur, John F. Dewey, H. P. Eugster, R. Allan Frazer, Kazuya Fujita, G. D. Garland, Robert Gall, Hugh C. Haard, Mark H. Houck, Florian K. Lahner, Bruce D. Marsh, David W. McGrath, Ronald T. McLaughlin, Harry Y. McSweeney, Masao J. Molina, Patar Molnar, Marie Mortazews, James R. Rice, Garard Schubert, K. P. Schwarz, George F. Shuman, A. K. Sinha, John M. Sinton, John G. Stomar, Jr., Francisco Suarez, T. E. Uhny, Rob Van der Voo, David R. Vobian, James A. Whitney, David V. Witschko, Derek York.

One Member: Maha Abdalla, Sunil Kumar Addy, Thomas D. Aiken, James Ivan David Alexander, Raymond Anderson, Raymond E. Arvidson, Larry P. Atkinson, Milo M. Backus, Anolita Badan-Dangon, Samuel J. Barnes, Aaron Barnes, Larry Barrows, Douglas L. Baumgardt, John W. Belcher, James P. Bennett, Jonathan H. Berg, Robert A. Berner, Robert L. Bernstein, Glenn O. Bertaux, N. K. Bewers, Kevin T. Biddle, Selene Billington, Jackson O. Blandin, James G. Blanco, W. Frank Bohlen, Stephen L. Bolivar,

W. F. Brece, Rafael L. Bres, David A. Brooks, Larry D. Brown, Robert C. Brown, Roger G. Burns, Peter Buseck, John C. Butler.

Douglas R. Caldwell, Melcolm J. Camball, Phillip A. Cendels, G. R. Carrigan, Richard W. Carlson, Robert F. Carlson, Robert S. Carmichael, Chalon L. Carns, Roy Carpenter, Edward Chang, Richard L. Chese, David Chishev, Abraham H. Chen, Gary K. C. Clarke, Lawrence Collin, Bestleah Jacob Collette, Jim Constant, Bruce H. Corliss, Peter Cornillon, Allan V. Cox, Patrick A. Crowley, C. Curran, Paul E. Damon, James F. Daniel, Khirid C. Doss, Geoffrey F. Davies, John N. Davies, Paul Davis, Richard W. Davis, David R. Dawdy, Roland A. de Szoeke, Anthony Charles Delany, Steven R. Dickman, Robert S. Dietz, S. Lawrence Dingman, Richard Diteen, Janet A. Docks, John H. Doolittle, John J. Dowling, John J. Drake, Al Dubs, Fredrick Duaneblar, Timothy Durbin, William B. Durham, Robert F. Dyrner.

Peter S. Eagleson, Stephen Ehrenberg, Leo M. Elser, Robert M. Ellis, Brooke B. Ellwood, Terry Engelder, Irene M. Engle, Albert J. Erickson, E. J. Essene, J. R. Evans, David Fahlgut, Donald Farley, Gerald L. Feder, Michael Fehler, William C. Feldman, Myron B. Fiering, Erik G. Finnstrom, Harold Carlton Flitz, Jr., Donald W. Forsyth, Edward A. Frankovic, Carl Fricks, Cliff Frohlich, Yoshio Fukuo, Anthony F. Gangl, Douglas H. Garbin, Michael O. Garcia, George Donald Garlick, Joel R. Gal, John William Gelesman, Walter Gekelman, Daniel T. Georgi, Joe Gettrust, Christoph K. Goertz, Fraser Gogg, Alan Goodacre, Sersh Goodin, John T. Goelling, Darrin Gredy, James W. Granseth, Norman K. Grant, Ronald Grasey, John P. Graenhouse, Eugene Graessl, L. Trowbridge Grose, D. Gubins, John H. Guawee.

Bradford H. Hager, Douglas A. Helth, Francis R. Hell, James M. Hell, Leo M. Hall, Stuart A. Hall, Donald R. F. Harleman, Gregory D. Herper, Trevor Nath Hart, Akira Hasegawa, Richard H. Hawkins, Stanley P. Hayes, James Fred Hays, Walter J. Helkila, Donald V. Haimberger, John H. Helsdon, Jr., Jim Harring, Norman Harz, John B. Higgins, Joseph W. Hlman, Robert M. Hirsch, Eve J. Hoffmann, John H. Hoka, Robert W. Houghton, Shih-Ang Hsu, Kenneth L. Hunkins, David Huntley, Violet Rosemary Strachen Hutton, Simon Ince, Mizuko Ishida, David D. Jackson, Wolfgang R. Jacoby, Raymond Janozic, A. I. Johnson, Peter Jumaras, Glenn H. Jung, William A. Jury, Jack A. C. Kaler, Douglas L. Kana, William M. Kestner, John Katsulakis, Robert Kay, Elvin Kellso, Paul Kintner, Paul H. Kirshen, Peter K. Kitanidis, David M. Klumpar, Kenneth P. Kodama, Nicholas Kouwen, Soterios M. Krimigis, Richard J. Kullbust.

Paul E. La Violette, Theodore C. Labotka, Antonio C. Laage, Charles Russell Lawrence, Lawrence A. Lawver, Tay-How Lee, Tian-Chang Lee, Straul Lavi, S. Banadict Levin, Edward R. Levine, Robert C. Lieberman, Marvin Lilley, Robert J. Lillie, Thomas E. Lisle, Ivan Lissauer, S. W. Lohman, Marc Lohelle, Richard R. Luckey, W. C. Luh, Gregory A. Lyzanga, William D. MacDonnell, Peter F. MacDors, David C. Major, William V. R. Malkus, Jose Roberto Manzano, Quarnval Mercal, George O. Marmoro, Philip Marsh, Edward A. Martell, John C. Maxwell, Michael J. McEachern, Patrick S. McIntosh, Malcolm C. McKenna, Dan McKenna, William F. McKenna, Karen McNally, R. H. McNutt, Murray B. McPherson, Michael O. McWilliams, Ronald Mesa, H. J. Melosh, Wendell W. Mendall, Richard P. Mlad, Chester Miller, Gary L. Mille, Andrew S. Milman, Hiroshi Mizutani, Allen Moench, Erik Molo-Christensen, El-dridga Mours, Millett G. Morgen, Donald A. Morrison, Marshall E. Mose, W. R. Muehlberger.

Andrew F. Nagy, Michael T. Nance, T. N. Narasimhan, Donald R. Nielsen, Aeron N. D. Kirk Nordstrom, Dag Nummedal, Amos Nur, K. M. O'Connor, Jerry S. Olson, Peter Olson, Neil D. Opdyke, Marek Orr, Harold D. Orville, Aaron J. Owens, Suresh Pal, Carl D. Palmer, James J. Papka, E. M. Pasmantier, David K. Parrish, David F. Paszkewsky, Tsung-Hung Peng, Wayne D. Pennington, Mary Jane Perry, Alan R. Peltarfreund, John A. Philpotts, Kathleen Poole, Thomas A. Polansky, Frederick Priel, Ronald G. Prinn, Edward L. Procyshyn, William A. Prothero, Jr., Philip D. Rabinowitz, Srinivas C. Rao, Kenneth H. Reckhow, Ian Reid, R. J. Renard, Sol Raenick, Ray T. Reynolds, Philip G. Richards, Randall M. Richardson, A. K. Richter, Robert E. Rieckner, John K. Robertson, Edwin S. Robinson, Robert Robinson, Raymond G. Robie, Michael G. Rochester, C. K. Ross, John W. Rudnick, Patrick J. C. Ryell.

Nasir Adeb Saad, Robert A. Saar, Takao Saito, Yoshiko Sato, Ulrich Schmidt, Janet A. Schramme, Steven J. Schwartz, Harry E. Schwarz, Charles B. Selar, Jon T. Scott, Donald R. Saely, Sandro Serra, Allen M. Shapiro, Denis M. Shaw, Kunhiko Shimazaki, Charles H. Shultz, David W. Simpson, Shri Krishna Singh, James R. Sisk, Norman H. Sleep, A. P. Socolow, Douglas Smith, Raymond C. Smith, Stuart D. Smith, J. Arthur Snoka, Bengt Sonnerup, Thomas W. Spence, Joseph J. Spigel, William A. Spragg, P. Srinivasan, Jary Russell Stadinger, R. R. Staeves, Reiner L. Stanzel, Don Starmann, Edward Stojar, Keith D. Stolzenbach, D. W. Strangway, Robert G. Strom, William Surges, John S. Sumner, Kiyoshi Suyehiro, Lynn Sykes.

Ronald C. Taylor, Michael D. Taubman, Lawrence W. Teufel, Thomas M. Tharp, Friedrich Thallan, Dena Thompson, Jr., Kent W. Thornton, Robert Thurnell, George R. Tilton, Alfred Toennissen, Marahs R. Torr, Allan H. Treisman, Carl Christian Teichgraber, Jan Tullis, Terry E. Tullis, Donald L. Turcotte, Amjad Umori, Kenneth L. Verosub, J. Vavrika, Thomas A. Vogel, Richard Vondrek, Joachim Voss, David Walker, Raymond J. Walker, John B. Waks, Donald Waldner, Alan Welch, Erhard P. Werth, Warren B. White, William B. White, Albert J. Williams, III, Douglas F. Williams, Richard T. Williams, Clark R. Wilson, John W. Winchester, Donald U. Wisa, George T. F. Wong, Tang-long Wong, Eric Wood, James Wright, Francis T. Wu, Kiyohumi Yumoto.

Travel Grants for IAGA and IAMAP Assemblies Awarded

AGU recently received from the National Science Foundation block travel grants for U.S. scientists to attend the Third Scientific Assembly of the International Association of Meteorology and Atmospheric Physics (IAMAP) to be held in Hamburg, Germany, August 17-28, 1981, and the Fourth Scientific Assembly of the International Association of Geomagnetism and Aeronomy (IAGA) to be held August 3-15, 1981, in Edinburgh, Scotland. The IAMAP proposal was cosponsored by American Meteorological Society.

A total of 54 scientists were funded with the two grants, and the scientists ranged in age from 26 to 71, with the average age of 42 for the IAMAP grant recipient and 39 for those receiving IAGA grants. Fifteen were from the eastern part of the country, 18 from the central part, and 21 from the west coast, including Alaska. Two students were among those funded, one from each grant.

There were 53 applicants for funds from the IAMAP grant. Of these, 33 were funded with average grants of \$775. Four will go to both the IAGA and the IAMAP meetings: Janet G. Luhrsman, Knut H. Stamnes, David J. Stevenson, and Robert G. Roper. Other receiving grants to attend the IAMAP meeting are Richard A. Anheas, Susan K. Avery, Louis J. Batten, Alfred K. Blackadar, David W. Buchanan, Andre A. Donesud, Kerry A. Emanuel, Claude J. Frankignoul, Michael Garstang, David D. Houghton, Barry J. Huebert, Kol C. Jayaweera, Carl W. Kretzberg, Richard Gary Layton, Yaong-Jar Lin, Byrd W. Mosher, David G. Murray, Jaroma Namias, Gregory D. Naylor, Tekehi Ohtaka, Joyce E. Panner, Roger A. Pielke, Ruth A. Rack, Gary J. Rottman, Philip B. Rueessell, David C. Sands, Vinod K. Saxena, Russell C. Schnall, and Anna M. Thompson.

There were 73 applications for funds to attend the IAGA meeting, of which only 21 could be funded. The average grant was \$800. Grant recipients are Suhail K. Atreya, Subir K. Banerjee, Jeffrey M. Forbes, Michael D. Fuller, Susan Ganguly, John T. Goelling, John F. Harnandes, David D. Jackson, Margaret G. Kivalson, Shalindra Kumar, Steven P. Lund, Christopher P. McKay, Christopher T. Russell, Michael Schulz, Thomas J. Shunkland, Anthony C. Fraser-Smith, Rob Van der Voo, Craig A. Tapley, Raymond J. Walker, Richard L. Walterach, and Richard A. Wolf.

Meetings

International Radio Science Meeting

The 1982 International Symposium sponsored by the IEEE Antennas and Propagation Society (IEEE AP-S), the National Radio Science Meeting sponsored by USNC/URSI Commission, and the Nuclear Electromagnetic Pulse Meeting (NEM) will be held jointly at the University of New Mexico in Albuquerque, May 24-28.

A joint call for papers has been issued. Abstracts due January 4, should be sent to Kendall F. Casey, The Dikewood Corp., 1813 University Boulevard, N.E., Albuquerque, NM 87102. Requests for general meeting information should also be directed to him. Inquiries on the technical program should be directed to the respective technical program committee chairmen: IEEE AP-S: K. F. Casey and B. K. Singarayer; USNC/URSI: K. F. Casey; and NEM: K. C. Chan and L. D. Scott.

Information on accommodations and travel should be requested from Denise Grigio, Albuquerque Convention and Visitors Bureau, 401 Second Street, N.W., Albuquerque, N.Mex. 87102 (telephone: 505/243-3989).

Coal's Effect on Water Quality

A call for papers has been issued for the International Conference on Coal-Fired Power Plants and the Aquatic Environment. The conference is scheduled for August 18-19, 1982, in Copenhagen, Denmark.

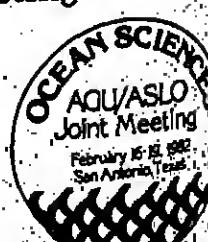
The meeting will address three sources of water pollution (thermal, solid waste, and airborne particles) and the corresponding prevention measures.

The conference is sponsored by the International Association on Water Pollution Research, the International Union of Pure and Applied Chemistry, and the Nordic Cooperative Organization for Applied Research.

December 31 is the deadline for abstracts. For additional information, write to Dia Congress Service, Linda Ale 48, DK-2720 Copenhagen, Denmark.

Ocean Sciences: AGU/ASLO Joint Meeting

February 16-19, 1982
San Antonio, Texas
Convener: W. D. Nowlin, Jr. (AGU) and R. W. Eddy (ASLO)
Call for papers published in EOS, June 23.



1981 Spring Meeting Report

Approximately 2150 participants registered for the 1981 Spring Meeting. More than 1500 papers were presented. The spaciousness of the Baltimore Convention Center provided ample opportunity for attendees to exchange ideas and interact with their colleagues. Here are some candid shots.

Changes to the program and late and revised abstracts are printed below.



Papers Not Presented

G38, K. S. Wallace et al.
G58, T. M. Hoser and C. K. Seyfert
H73, D. P. Dethier; H75, S. W. Whaatest et al. R. W. Buddemeyer; H79, L. E. Dunlap and J. M. Spinazola.
M2, R. M. Endlich et al.; M9, P. G. Black et al.
O18, C. T. Carlson et al.; O19, W. McLish et al.; O78, R.

Chambers and N. Hewley; O103, R. J. Spencer et al.; O132, F. R. Stegall and S. Bloch; O133, T. J. Barrett; O134, T. J. Berratt et al.; O152, D. G. Aubrey and P. E. Speer.
P45, S. Kumer and H. A. Taylor, Jr.; P54, T. E. Crevens et al.
S9, R. G. Daniel; S10, M. Caputo; S31, S. R. Taylor; S33, M. E. Monfort; S81, C. A. Langston; S87, C. A. To-seya.

Late Abstracts

IA INVITED PAPER

MODELS AND WATER RESOURCES DECISION-MAKING

Chin Anneli
Henry Thade
Robert J. Zedler
Office of Technology Assessment, U.S. Congress, Washington, D.C. 20540

We investigated the use of models for water resource decision-making by 19 federal agencies, by all 50 states, and by 13 major resource problems. Preliminary findings include:

1. Models are most often used to assist operational management and small-scale planning. They have less frequently been integrated into comprehensive river basin planning and policy making.
2. Although water resource models are as extensive as the federal level, water-related modeling efforts have been sparse.
3. While water resource models are used, many states would like to broaden their modeling capabilities. However, due to limited resources and poor information about model availability, most states are unable to improve their capabilities.
4. There is a wide variation in the quality and utility of water resource models. However, information about the quality or appropriateness of these models is difficult to obtain, and in many instances unknown due to a lack of model evaluation.
5. In the past, model development activities have received primary emphasis, without adequate attention to technology transfer and user support. Attention to institutional support, as well as a problem solving approach, has been lacking.

IC INVITED PAPER

FEDERAL RESEARCH SUPPORT FOR MODELS

William E. Butcher (Division of Civil and Environmental Engineering, National Science Foundation, Washington, D.C. 20555)

The use of water resource models is pervasive throughout the federal government. Agencies with a specific mission in mind, both in the past and present, have developed models to support their activities. Other agencies have mission in mind but have not developed models. This paper will discuss the role of the National Science Foundation and the Office of Water Research and Technology through research, models for other researchers and for professionals at large.

Many important models have been produced by federal agencies. Some are special purpose, others are general purpose and of broad utility. Research has been largely responsible for the increase in the number of models and in the quality of the models. It is proceeding to extend the range and power of presently available models.

IC INVITED PAPER

THE EFFECT OF WATER RESOURCES MODELS: DEVELOPERS' PERSPECTIVES

David Cohen (Department of Geography and Environmental Engineering, Johns Hopkins University, Baltimore, Maryland 21205)

This paper attempts to describe the needs and development of water resource models in the U.S. while addressing conceptual and methodological challenges and the widely debated concept of "model validation."

The vast area between the Sierra Nevada and the Coast Range is characterized by a complex topography and potentially successful environmental conditions. It is a changing natural environment, resulting from a complex interaction of natural and human factors which increases the risk of "desertification" for large segments of the population.

IC INVITED PAPER

SESSION OVERVIEW

Y. J. Haines, Director, Center for Large Scale Systems Policy Analysis, Case Western Reserve University, Cleveland, Ohio 44106

The purpose of this session is to evaluate the efficacy of modeling in water resource management. The session will focus on the following aspects and issues:

- (1) The response of water resource models to changing water resource needs today?
- (2) How can the efficacy of these models be improved?
- (3) How can the efficacy of these models be improved?
- (4) How can the efficacy of these models be improved?
- (5) How can the efficacy of these models be improved?
- (6) How can the efficacy of these models be improved?
- (7) How can the efficacy of these models be improved?
- (8) How can the efficacy of these models be improved?
- (9) How can the efficacy of these models be improved?
- (10) How can the efficacy of these models be improved?



ANTON L. HALES SYMPOSIUM

The Geosciences Program of The University of Texas at Dallas will sponsor a Symposium entitled

"SOME RECENT ADVANCES IN GEOPHYSICS"

on October 5-6, 1981, in honor of Dr. Anton L. Hales on his 70th birthday.

The Symposium will consist of two days of invited talks by internationally known speakers from academia and industry on recent developments in geophysics with an emphasis on seismology. Topics will include recent COCORP results, modelling reflection seismograms, heterogeneous earth structure, attenuation of seismic waves, and global tectonics.

For additional details and registration information, contact Richard M. Mitterer or Ronald W. Ward, Programs in Geosciences, The University of Texas at Dallas, P.O. Box 888, Richardson, Texas 75080. Telephone: 214-690-2401.

SA62, S. Ganguly.
SM39, D. R. McDermid; SM50, P. F. Fougere; SM60, R. D. Sears; SM67, C. W. Dubs; SM83, H. H. Sauer et al.; SM142, H. A. Garcia; SM174, W. Calvert.

T39, M. C. Mallin; T40, M. P. Ananda et al.; T78, O. L. Anderson and Y. Sumino; T101, S. N. Cohn; T141, G. Mavko; T188, L. D. McGinnis et al.

V4, A. Meijer; V55, B. C. Chakoumakos and G. V. Gibbs; V77, J. Hamel et al.; V144, T. A. Hudson and R. D. Dalmayer; V152, A. A. Eggers; V191, A. Baldasari; V208, E. S. Polam et al.; V209, J. R. Smyth and F. A. Caporuscio; V210, S. Bloch.

Given the richness of the 1981 Spring Meeting, the following topics are suggested for discussion and debate. These topics are intended to stimulate discussion and debate among participants in the Symposium. The topics are: (1) The role of models in water resource decision-making; (2) The role of models in water resource decision-making; (3) The role of models in water resource decision-making; (4) The role of models in water resource decision-making; (5) The role of models in water resource decision-making; (6) The role of models in water resource decision-making; (7) The role of models in water resource decision-making; (8) The role of models in water resource decision-making; (9) The role of models in water resource decision-making; (10) The role of models in water resource decision-making.

DISCUSSION TOPIC: WATER AVAILABILITY FOR SYNTHETIC FUEL DEVELOPMENT. OVERVIEW
Paul J. Stone (Office of Technology Assessment, United States Congress, Washington, D.C. 20540)

DISCUSSION TOPIC: WATER AVAILABILITY FOR SYNTHETIC FUEL DEVELOPMENT. OVERVIEW
Leo M. Hall (Melpre Water Engineers, Inc., Denver, Colorado 80211) (Sponsor: P. J. Stone)

DISCUSSION TOPIC: WATER AVAILABILITY FOR SYNTHETIC FUEL DEVELOPMENT. OVERVIEW
Maurice Gold (Water Participation Associates, Cambridge, Mass. 02142) (Sponsor: P. J. Stone)

DISCUSSION TOPIC: WATER AVAILABILITY FOR SYNTHETIC FUEL DEVELOPMENT. OVERVIEW
Frederick A. Elzys (USGS, Reston, Virginia 20192) (Sponsor: P. J. Stone)

DISCUSSION TOPIC: WATER AVAILABILITY FOR SYNTHETIC FUEL DEVELOPMENT. OVERVIEW
Gerald S. Smith (U.S. Water Resources Council, Washington, D.C. 20037) (Sponsor: P. J. Stone)

DISCUSSION TOPIC: WATER AVAILABILITY FOR SYNTHETIC FUEL DEVELOPMENT. OVERVIEW
Harvey Banks (Camp Dresser McKee, Inc., Belmont, California 94002) (Sponsor: P. J. Stone)

DISCUSSION TOPIC: WATER AVAILABILITY FOR SYNTHETIC FUEL DEVELOPMENT. OVERVIEW
To be announced

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